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Specification and Drawings, as originally filed, with Application for Patent Serial No: **2,411,881**, on November 15, 2002, by **MANFRED A. A. LUPKE AND STEFAN A. LUPKE**, for "Molding Apparatus with Mold Blocks Having Face Adjustment".

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ABSTRACT OF THE DISCLOSURE

A pipe molding apparatus includes a plurality of mold blocks which move along a molding path to form double wall plastic pipe having an outer pipe wall with corrugations which set outside diameter of the pipe and an inner wall around a bore through the pipe. The mold blocks have profiled faces which determine shape of the pipe. The profiled faces are reconfigureable in profile between first and second face profiles to vary both depth of the corrugations and diameter of the bore through the pipe without varying external diameter and while maintaining essentially constant wall thickness of the pipe.

MOLDING APPARATUS WITH MOLD BLOCKS HAVING PROFILED FACE ADJUSTMENT

FIELD OF THE INVENTION

The present invention relates to a pipe molding system including a mold tunnel formed by moving mold blocks in which the shape of the pipe can be varied without having to replace the mold blocks.

BACKGROUND OF THE INVENTION

In a traditional pipe molding apparatus of the type using mold blocks which move along a molding path to form what is known as a moving mold tunnel, the only way to change shape of the pipe is to replace the pipe forming mold block sections. This is very costly in that these mold block sections themselves are extremely expensive because they include features such as vacuum openings, cooling channels etc. required in the formation of the pipe. However, according to known pipe forming devices using moving mold tunnels it is a requirement to have interchangeable mold block sections to produce different shapes and sizes of pipes.

Different job applications require different pipe strengths even though the same diameter of pipe may be required for each job application. It would seem that a simple way of dealing with this situation is to vary the wall thickness of the pipe to make the pipe either stronger i.e., more rigid through increased wall thickness or to make the pipe softer i.e., more flexible through decreased wall thickness. However, industry standards dictate that a certain wall thickness is required which does not allow thinning of pipe walls for making a pipe more flexible.

Most pipes derive wall strength through the provision of corrugations at the outer surface of the pipe. It is known that a pipe with a taller corrugation is stronger than a pipe with a shorter corrugation. Again, according to known plastic pipe extruding processes it is not possible to vary the corrugation height of a pipe without replacement of the mold block sections in the corrugator.

SUMMARY OF THE PRESENT INVENTION

The present invention provides a molding system which is able to provide changes to the shape of an extruded pipe without having to replace the entire mold block sections in the molding system.

In particular, the present invention provides a pipe molding system which makes a continuous length of plastic pipe with the system including mold block sections having profiled faces which are refigurable in their face profile to provide pipe shape variances without having to replace the entire mold blocks.

According to an aspect of the present invention, the molding system includes a plurality of mold blocks which move along the molding path to form double wall plastic pipe having an outer wall with corrugations which set outside diameter of the pipe and an inner wall around a bore through the pipe. The sections of the mold blocks have profiled faces which determine shape of the pipe and those profiled faces are reconfigurable in profile between a first and a second face profile to vary both depth of the corrugations and diameter of the bore through the pipe. This is done without varying external diameter of the pipe while maintaining essentially

constant thickness of the pipe walls.

As a result of the immediately above aspect of the present invention a single molding system without the requirement for mold block replacement can be used to make either a stronger i.e., more rigid pipe or a softer i.e., more flexible pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

The above as well as other advantages and features of the present invention will be described in greater detail according to the preferred embodiments of the present invention in which;

Figure 1 is Figure 1 is a schematic view of a pipe molding apparatus used in a pipe mold system according to a preferred embodiment of the present invention;

Figure 2 is a further schematic view of the pipe molding region of the apparatus of Figure 1 with the mold blocks set up in a first face profile condition to produce a relatively flexible length of corrugated pipe;

Figure 3 is a further schematic view of the molding region of the apparatus of Figure 1 with the mold blocks set in a second face profile condition to produce a relatively rigid length of corrugated pipe;

Figure 4 is a front view of one of the mold block sections with the apparatus set up in the Figure 2 condition;

Figure 5 is a front view of one of the mold block sections of the apparatus set up in the Figure 3 condition; and

Figure 6 is a sectional view through the mold block section of Figure 4.

DETAILED DESCRIPTION ACCORDING TO THE PREFERRED EMBODIMENTS OF THE PRESENT INVENTION IN WHICH:

Figure 1 shows a pipe molding apparatus generally indicated at 1. This pipe molding apparatus includes an extruder 3 which provides molten plastic through plastic flow channels of an extruder die 5 to a moving mold tunnel generally indicated at 7. The moving mold tunnel is formed by a plurality of mold block sections 9 to each side of the mold tunnel. These mold block sections have profiled i.e., corrugated faces to receive plastic from the two channel mouths 6a and 6b of the die equipment located within the mold tunnel. The plastic emanating from channel mouth 6a flows into the troughs in the faces of the mold blocks to form an outer corrugated wall of the pipe. The plastic emanating through channel mouth 6b forms an inner pipe wall bordering a central bore through the pipe. The molten plastic of the inner pipe wall is set to shape and cooled by a cooling plug 11 internally of the mold tunnel.

Figure 2 of the drawings shows the apparatus set up to produce a double wall pipe 18 having an inner pipe wall 19 and an outer corrugated pipe wall 21.

Each of the mold blocks 9 includes a trough 13 to shape the corrugations 21 on pipe 18. These corrugations set the outside diameter of the pipe.

Each of the mold blocks further includes a mold block crest between each of the troughs 13. In accordance with a preferred embodiment of the present

invention the height of this mold block crest is variable to vary the depth of the corrugations. This variance in turn produces a bore diameter change in the pipe with little or no change to the wall thicknesses of the pipe.

Again referring to Figure 2 of the drawings, each of the mold block sections 9 has a mounting surface 12 on each side of each of the troughs 13 in the mold block section. This mounting surface 12 is adapted to interchangeably receive different mold block crest forming attachments. In Figure 2, crest forming attachments 15 are mounted to each of the mold block mounting surfaces 12.

Now turning to Figure 3 it will be seen that the mold block sections 9 and in particular the profiled faces of the mold block sections have been reconfigured from the Figure 2 face profile to a different face profile. This is done by the attachment of crest forming attachments 23 to the mounting surfaces 12 of the mold block sections in the Figure 3 set up. Crest forming attachments 23 of Figure 3 are substantially longer than crest forming attachments 15 of the Figure 2 set up. Furthermore as will be seen in Figure 3 of the drawings the pipe generally indicated at 27 formed using the Figure 3 set up includes an outer wall formed by corrugations 31 which are substantially taller than the corrugations 21 of pipe 18 from Figure 2. Furthermore, in Figure 3 the bore diameter of the pipe 27 defined by the inner pipe wall 29 is substantially smaller than the bore diameter through pipe 18 defined by inner wall 19 in Figure 2. Accordingly, pipe 27 of Figure 3 is a substantially stronger or more rigid pipe than pipe 18 of Figure 2. However, the overall external diameter of the two pipes is identical. Furthermore, the wall thickness of pipe 18 is essentially the same as the wall thickness

of pipe 29.

The reconfiguration of the pipe from the Figure 2 pipe shape to the Figure 3 pipe shape is achieved simply by the use of interchanageble face attachments of different heights at the mold block faces without having to replace the mold block sections. In addition, it will be noted in Figure 3 that a smaller diameter cooling plug 25 has replaced the larger diameter cooling plug 11 to form the smaller bore pipe 27 of Figure 3.

Figures 4 and 5 of the drawings show a number of preferred features of the present invention. In particular, Figure 4 shows a mold block section 9 provided with the shorter crest forming members 15 supported by the mounting surfaces 12 to either side of the troughs 13 in the face of the mold block sections. Figure 5 on the other hand shows the taller crest forming members 23 fitted to the mounting surfaces 12 to either side of the trough 13 in the profiled face of mold block section 9.

A number of other features can be seen in Figures 4 and 5 of the drawings. In particular, these drawings show that the mold block sections include sophisticated vacuum and cooling channels required to first shape and then cool the plastic at the faces of the mold blocks. The interchangeability of the face attachments at the mounting surfaces 12 of the mold block sections in no way impedes or affects either the vacuum or the cooling channels.

Figures 4, 5 and 6 also show a particular means of replaceably mounting the face attachments to the mold block sections. This means comprises a bracket 35 having forwardly extending arms 37 and 39 to opposite ends of

the bracket. The mounting surface of the mold block section is provided away from the pipe forming region with a bore 40 to receive a threaded bolt 41. Also provided in the mold block section is a recess 10 for receiving the leg 39 of bracket 35. A similar recess 16 is provided in the face attachment 15 to receive the leg 37 of bracket 35.

As will be appreciated from the description above the bracket is easily secured to and removed from the mold block to secure face attachment 15 or to replace it with face attachment 23 which has a corresponding bracket receiving recess.

Although various preferred embodiments of the present invention have been described in detail, it will be appreciated by those skilled in the art that variations may be made without departing from the spirit of the invention or the scope of the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A molding system including a plurality of mold blocks which move along a molding path to form double wall plastic pipe having an outer wall with corrugations which set outside diameter of the pipe corrugations and an inner wall around a bore through the pipe, said mold blocks having profiled faces which determine shape of the pipe, said profiled faces being reconfigurable in profile between a first and a second face profile to vary both depth of the corrugations and diameter of the bore through the pipe without varying external diameter of the pipe.

2. A molding system as claimed in Claim 1, said profiled faces of said mold blocks when configured with the first face profile forming the pipe with a first corrugation depth and a first bore diameter and when configured with the second face profile forming the pipe with a second corrugation depth greater than the first corrugation depth and a second bore diameter less than the first bore diameter.

3. A molding system as claimed in Claim 2 wherein said inner wall of said pipe has a wall thickness that remains essentially constant when reconfiguring the profiled faces of the mold blocks between the first and second face profiles.

4. A molding system as claimed in Claim 2 wherein each said mold block includes a mounting surface and said system includes first and second mold block face attachments which interchangeably mount to said mounting surface for reconfiguring of the profiled faces of the mold blocks.

5. A molding system as claimed in Claim 4 wherein said profiled faces of said mold blocks include alternating crests and troughs to form the corrugations in the outer wall of the pipe, said first and second face attachments comprising first and second crest forming members, the first crest forming members being shorter than the second crest forming members and being used to provide the first face profile on the mold blocks, the second crest forming members being longer than the first crest forming members and being used to provide the second face profile on the mold blocks.

6. A molding apparatus as claimed in Claim 2 wherein said molding path includes cooling and shape holding means for the inner wall of the pipe, said means being diameter variable according to which face profile is provided on the faces of the mold blocks.

7. A molding system as claimed in Claim 6 wherein said cooling and shape holding means comprises first and second cooling plugs which are interchangeably fittable in said molding path, said first cooling plug having a diameter which is greater than that of said second cooling plug, the first cooling plug being used when the mold blocks have the first face profile and the second cooling plug being used when the mold blocks have the second face profile.

8. A pipe molding system which makes a continuous length of plastic pipe, said system comprising first and second mold block sections which circulate to and away from a mold tunnel into which a continuous stream of molten plastic is fed to form the pipe with an inner bore surrounded by a wall having an undulating exterior surface, the first mold block sections closing with the

second mold block sections to form a moving line of closed mold blocks while circulating through the mold tunnel and the first and second mold block sections parting from one another while circulating away from and back to the mold tunnel, both said first and second mold block sections having profiled faces which dictate shape of the pipe, said profiled faces including face attachments which are interchangeable at the profiled faces with other face attachments of different configurations to vary the shape of the pipe without replacing the mold block sections.

9. A pipe molding system as claimed in Claim 8 used to form the pipe with a smooth wall at the inner bore of the pipe and with a corrugated outer surface, the faces of the mold block sections having alternating crests and troughs on the profiled faces thereof, the face attachments comprising first attachments of a first length and second attachments of a second length, the first and second attachments being interchangeably fittable at the profiled faces of the mold block sections to vary height of the crests according to which one of said first and second attachments is fitted at the profiled faces which in turn produces a variance of depth of the troughs of the profiled faces of the mold block sections.

10. A pipe molding apparatus as claimed in Claim 9 including a locking member which releaseably locks each face attachment at each of the profiled faces of the mold block sections.

11. A pipe molding apparatus for making a continuous length of plastic pipe, said apparatus comprising first and second mold block sections each having profiled faces formed by crests and troughs on the profiled faces of the

mold block sections, a first set of face attachments and a second set of face attachments, the first and second sets of face attachments being interchangeably and releasably fittable to the profiled faces of the mold block sections, and first and second cooling plugs of diameters differing from one another, the first and second mold block sections circulating to and away from a molding tunnel of the apparatus which contains one of said cooling plugs, the mold tunnel receiving a continuous stream of molten plastic to form the pipe over the one of the cooling plugs with an internal bore and a wall having an undulating exterior surface around said bore, the undulating surface defining external diameter of the pipe, the first mold block sections closing with the second mold block sections to form a moving line of closed mold blocks while circulating through the mold tunnel and the first and second mold block sections parting from one another while circulating away from and back to the mold tunnel, said apparatus when in a first set up condition producing the pipe with a first bore diameter when the first set of face attachments are fitted to the profiled faces of the first and second mold block sections and when the first cooling plug is placed in the mold tunnel and the apparatus when in a second set up condition producing the pipe with a second bore diameter different from the first bore diameter while maintaining essentially constant wall thickness of the pipe when the second set of face attachments are fitted to the profiled faces of the first and second mold block sections and when the second cooling plug is placed in the mold tunnel, the external diameter of the pipe remaining constant in both the first and the second set up conditions of the apparatus.

12. A pipe molding apparatus as claimed in Claim 11 wherein said first set and second set of face attachments

interchangeably and releasably secure as crest forming members the of the profiled faces of the first and second mold block sections, the face attachments of the first set of face attachments being of a first length which is less than length of the face attachments of the second set of face attachments and the first cooling plug having a diameter greater than that of the second cooling plug and the second bore diameter of the pipe being less than the first bore diameter of the pipe.

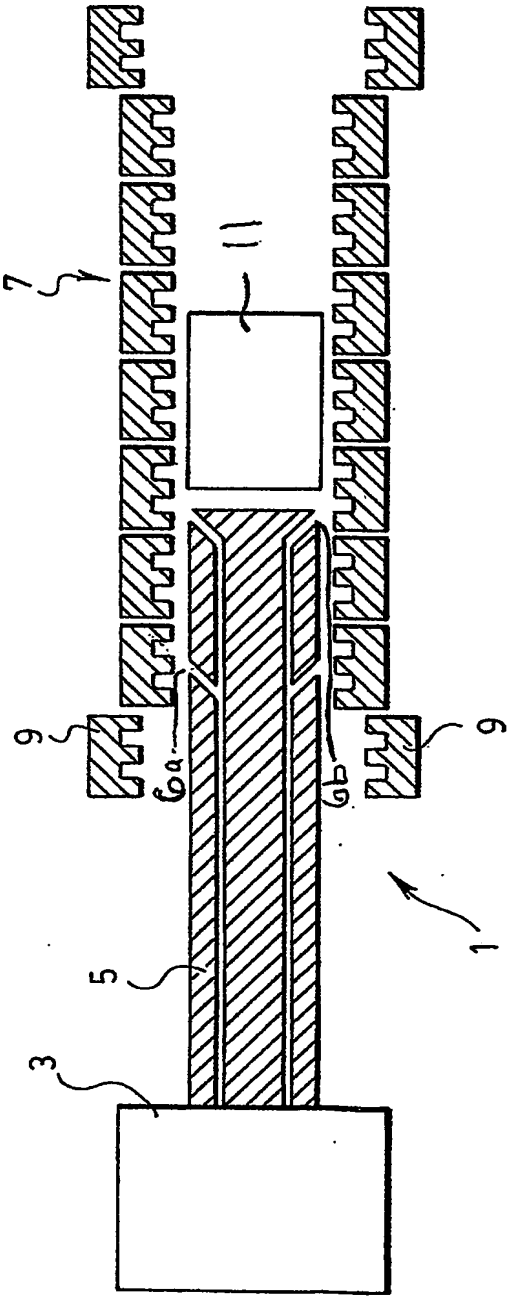

FIG.1.

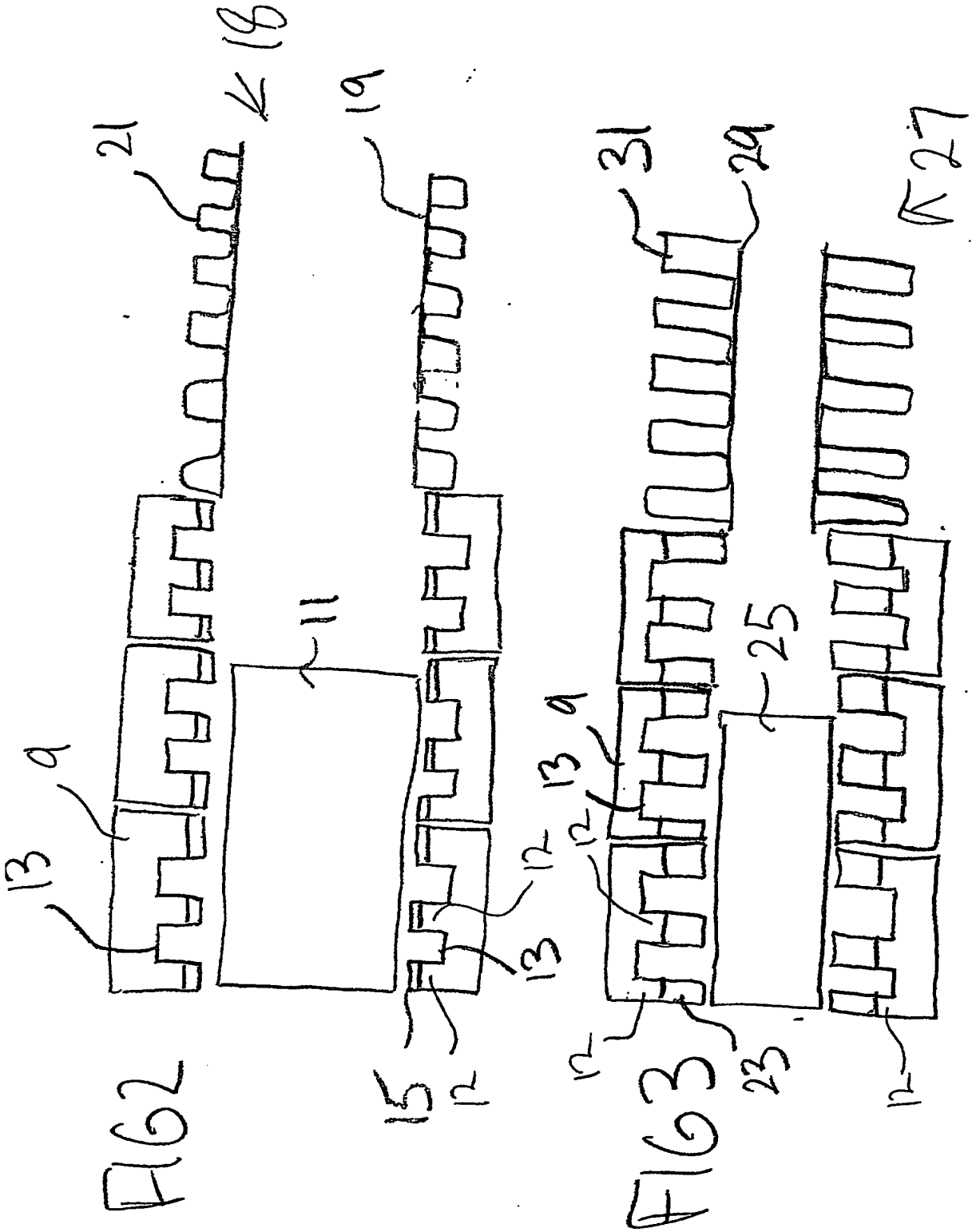
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FIG 2
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FIG 3

Fig 4

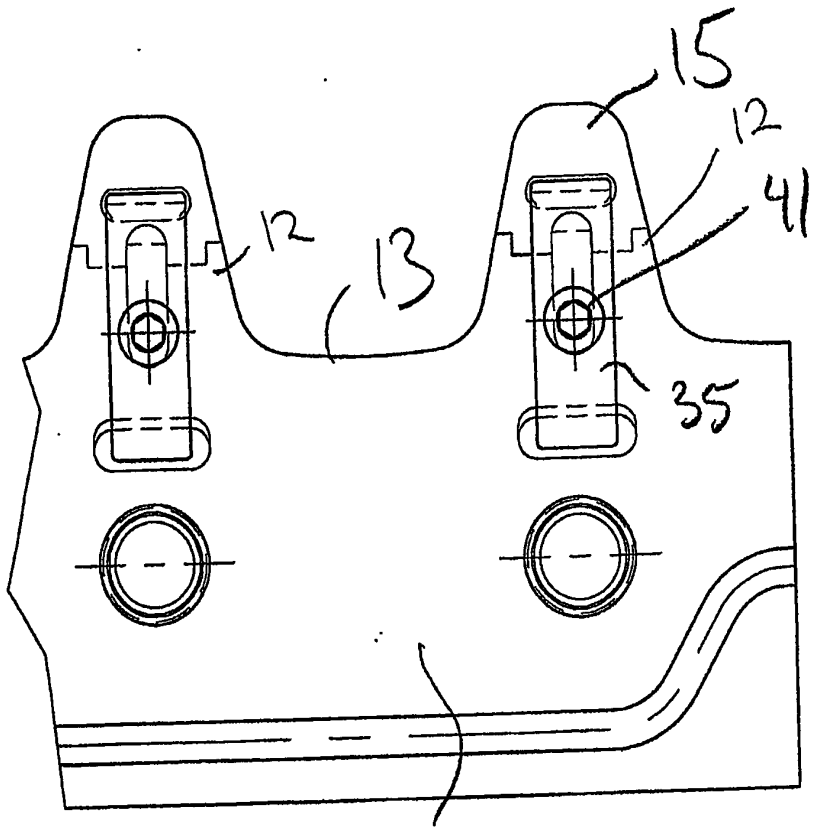


Fig 5

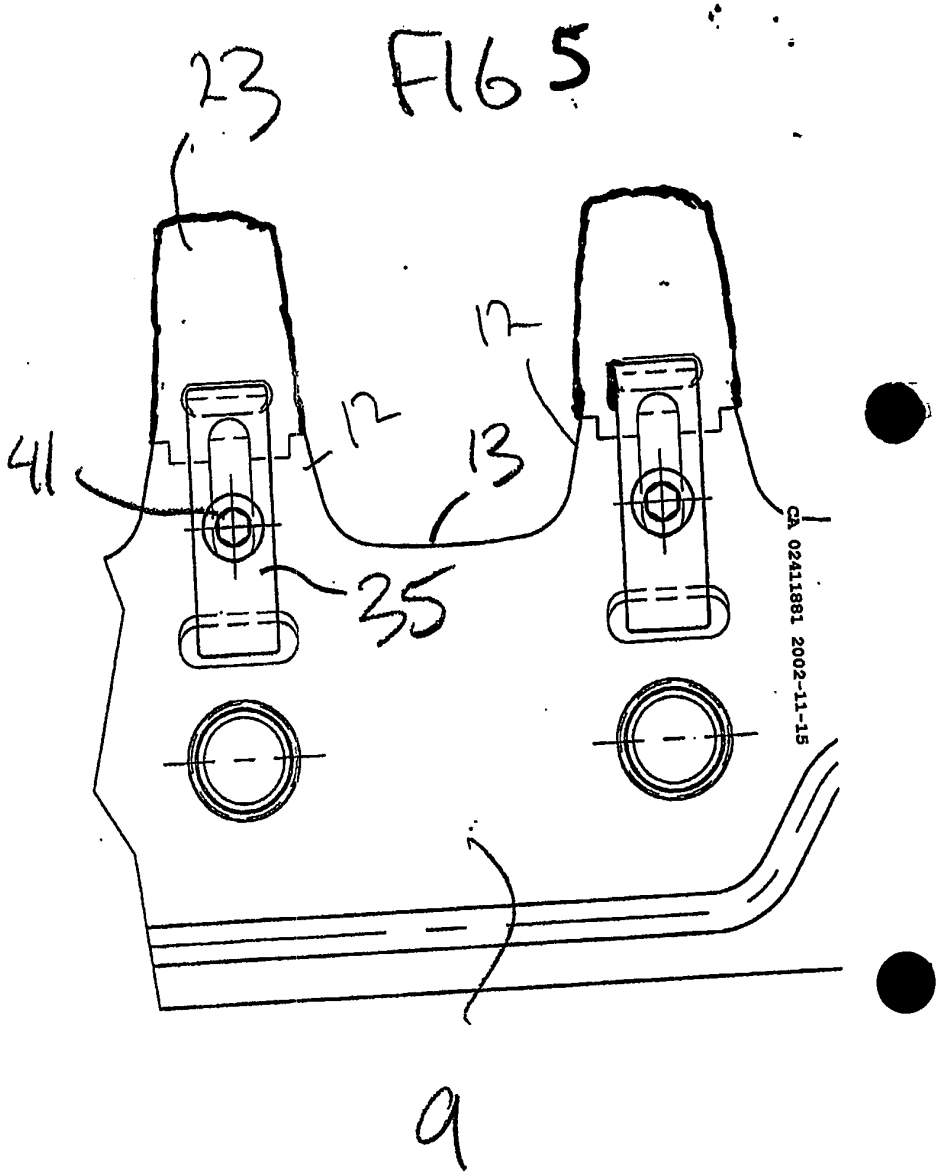
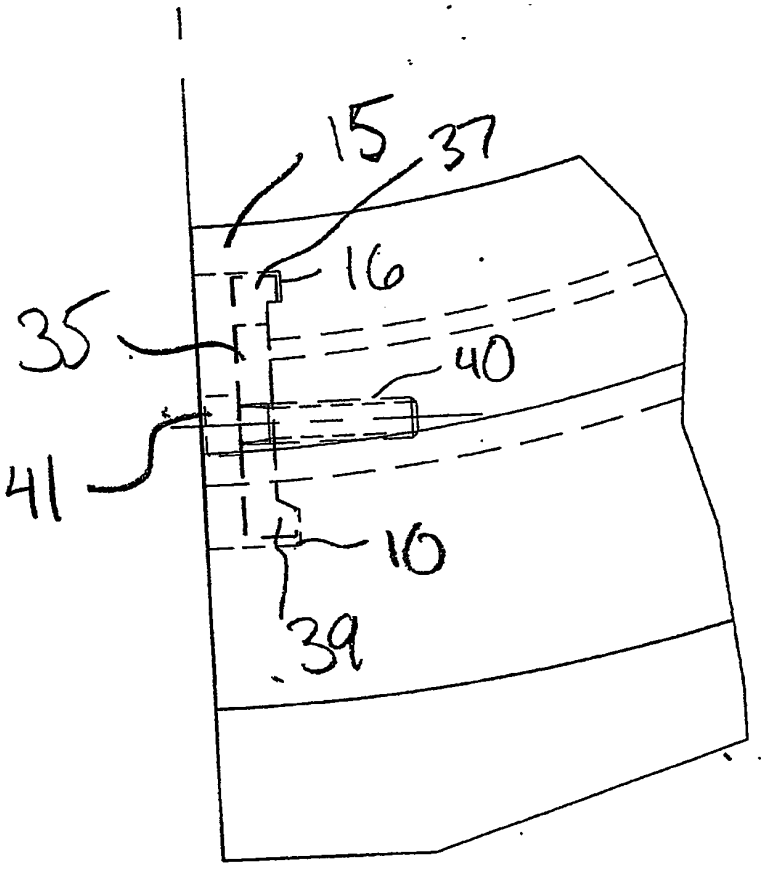


FIG 6



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